

# Network Output Measures Health & Risk Reporting Methodology & Framework

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Safety and Reliability Working Group  
Rebasing Methodologies

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## 1. Definitions

Term	Definition
Asset Base	The assets represented in the models, volumes and attributes such as age.
Direct Translation	The interventions specified in the monetised risk models are as stated in the GD1 plan narratives, as adjusted by Final Proposal. That is to say, the volume of work are identical in original documentation and in the new risk model.
Equally Challenging / Equivalent Impact	These terms have been used interchangeably by Ofgem. They require that the volume of interventions identified in original business plans, as adjusted by Ofgem's Final Proposals, are transferred into the risk model to calculate a risk removal delta.
Performance	The metrics used to compare the behavior of an asset against expected behavior/standards, over time or in comparison to other assets
RIIO-GD1	RIIO-GD1 is the first gas distribution price control review to use the RIIO model (Revenue = Incentives+ Innovation+ Outputs) of network regulation. The RIIO-GD1 price control sets out the outputs that the eight Gas Distribution Networks (GDNs) need to deliver for their consumers and the associated revenues they are allowed to collect for the eight-year period from 1 April 2013 until 31 March 2021
Special Condition 4G	Methodology for Network Output Measures. The purpose of this condition is to ensure that the Licensee develops, implements and maintains a Methodology for Network Output Measures and information gathering plan that achieves the objectives set out in Part B of this condition.
Special Condition 4H	Specification of Network Outputs. The purpose of this condition is to specify the Network Outputs the Licensee must deliver during the Price Control Period and the incentive reward or penalty associated with material over or under-deliveries against those outputs.
SRWG	The Safety and Reliability Working Group

## 2. Introduction

As part of the RIIO-GD1 framework, a secondary deliverable covering asset health and criticality was specified as part of a suite of outputs related to asset reliability. This secondary deliverable is defined within Special Condition 4G of the gas transporter licence. Associated incentive/penalty arrangements are defined within Special Condition 4H.

Special Condition 4G covers two outputs: 'asset health, criticality and risk' (HCR) and 'capacity utilisation'. Together they are known as the Network Output Measures (NOMs). The capacity utilisation measure has been fully defined, and reports have been submitted as part of the Regulatory Reporting Pack (RRP) for each year of RIIO-GD1. This document focuses only on HCR.

Initially, the HCR output was established as a set of indices: HI1 to HI5 for asset health, CI1 to CI4 for criticality and RI1 to RI5 for asset risk. Following direction from Ofgem, each Gas Distribution Network (GDN) submitted workbooks containing targets for the HCR output against their own individual methodologies. These targets included the following points:

- Position as at 1 April 2013
- Position as at 31 March 2021 without intervention
- Position as at 31 March 2021 with intervention

Ofgem rejected the workbooks approach having identified that the indices, as they stood, did not allow a comparison between asset groups, since each index was unique to an individual asset group. Therefore, a new methodology was derived, which expressed health as a form of reliability (failures per annum), criticality as a form of monetary consequence and risk in the form of monetised risk. Special Condition 4G requires the licensees to work together to develop and submit a NOMs Methodology for HCR.

The GDNs submitted the first NOMs Methodology in September 2015.

In its letter dated 15 December 2015, Ofgem specified that it was minded to support the submission of the NOMs methodology if aspects of the document were updated and re-submitted in March 2016. Ofgem also issued direct modifications to the NOMs Methodology under Special Condition 4G. The modifications were listed in Annex 1 to that letter. Item 4 in Annex 1 specified:

*"Tracking is completed by July 2017 to establish targets using the new NOMs Methodology to ensure the new targets have an equivalent impact as the original targets."*

The term 'equivalent impact' is judged to be the same as the term 'equally challenging' used in 'Part E: Rebasing of Special Condition 4H', where 4H.14 states that "the Network Outputs remain equally challenging as those set out in the Workbook".

The Safety and Reliability Working Group (SRWG) has interpreted this requirement to mean that each GDN will 'rebase' their 2013 business plan interventions, using the new monetised risk (MR) methodology and report the equivalent risk delta. This will allow Ofgem to evaluate the delivery of planned investment and quantify any under and over performance. The new baseline will state what any given GDN's investment outputs would have been, had the MR methodology been used at 1st April 2013 – the start of the GD1 period. 'Intervention' in this context means the company's Business Plan for RIIO GD1 as amended by the Final Proposals (FPs) published by Ofgem on 17th December 2012.

Within the 2017 rebasing submission, each GDNs will report the following monetised risk outputs.:

1. The monetised risk position as of 1 April 2013
2. The projected monetised risk as of 31 of March 2021, assuming no interventions were carried out from the start of the RIIO period
3. The projected monetised risk as of 31 March 2021, assuming that the interventions, published in FPs by Ofgem and accepted by the GDNs, will be carried out during the period
4. The monetised risk position as of 31 March 2017, showing the monetised risk position today, this captures the sum of actual interventions undertaken during GD1 to date

Points 1 to 3 reflect the FP position, the agreed business plan at the start of GD1. In particular, it should be stressed that the position in 2021 (Point 3) is a forecast of the risk position based on the FP; it does not represent where companies believe they will outturn. Point 4 is a statement of the actual position in 2017; this is not necessarily the position in 2017 that might have been envisaged when the FP was agreed.

### 3. Guiding Values of Rebasing

The key principle is that rebased targets shall be as “equally challenging” as the original ones for GDNs to meet and outperform. It is important to note that the HI/RI indices outputs approach rejected by Ofgem and the monetised risk outputs are not directly comparable, as they are significantly different models i.e, HI/RI output is a 5x4 matrix of asset numbers, monetised risk output is a financial assessment of risk. The ‘equally challenging’ requirement can only be achieved through consistent treatment of model inputs, namely the RIIO-GD1 intervention plans.

The five general principles:

1. Rebased targets shall be as equally challenging as the original ones for GDNs to meet and outperform
2. Best endeavours to ensure no error and accurate reflection of health and criticality of assets
3. Apply same the principles as used in RIIO-GD1 business plans
4. Apply the same assumptions as applied in Authority’s Final Proposals
5. Direct translation of original investment plan wherever appropriate

GDNs will, to best endeavours, ensure that the submission is compiled using robust methods and that the data is free from error and accurately reflect the health and criticality of assets. Any errors that are identified with the original FP must be highlighted, with justification provided for a proposed solution that enables Ofgem to carry out an assessment.

The rebased intervention plan, where appropriate, shall be a direct translation of, and consistent with, the original intervention plan. This is to ensure the new targets have an equivalent impact to those originally set. Where this is not appropriate, the principles from the original intervention plan will be used to produce a restatement that reflects the original as closely as possible. The rebased intervention plan should ensure consistent volumes of interventions at a category level and make no attempt to revise the original intervention plan.

For convenience and consistency all values will be stated in the same price base, the SRWG propose that cost will be report in a 2014/15 cost base.

## 4. Overview of Rebasing

In order to examine rebasing, it is useful to describe the basic aspects.

Figure 1 shows a view of a hypothetical monetised risk rebasing with uniform levels of intervention each year: four years of actual investment between 2013 and 2017 (left hand graph) and forecast investment between 2013 and 2021 (right hand graph). The risk values are shown about the 2013 start point (100%).

- The black line AB (left chart) shows the movement in actual monetised risk between 2013 and 2017 as a result of the interventions carried out to date.
- The black line AE (right chart) shows the forecast level of risk in each year as a result of interventions planned by a company in its business plan (FP). Point E will be derived from A. NB the line AE will only pass through point B if actual work delivered exactly matches an even profile of the eight year plan.
- The saw-tooth line shows how the monetised risk is reduced each year through carrying out the interventions.
- The green line AD shows what the baseline would have been in 2013 if the MR without-intervention calculation had been carried out at that time. Point D will be derived from Point A.

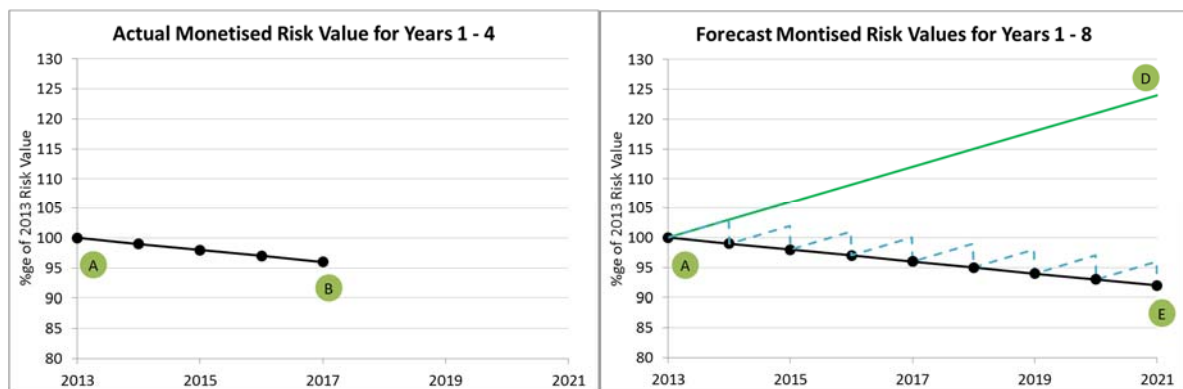


Figure 1 Stylised Representation of Rebasing

In respect to the items outlined in the rebasing submission:

1. Point A is the monetised risk position as of 1 April 2013
2. Point D is the projected monetised risk 2021, without intervention
3. Point E is the projected monetised risk 2021, with intervention
4. Point B is the monetised risk position as of 31 March 2017

Point A may be established by various means, records may be available for 2013 or a process of 'winding back' from the present asset base and level of performance (Point B) may be used. It is also possible to wind forward from asset observations made prior to 2013. These approaches will be expanded below.

## 5. Factors Affecting Monetised Risk Rebasing

The actual profiles of risk and risk reduction in a real example will be more complex. Risk is affected by various factors including the scheduling of when interventions are carried out, differences in risk factors before and after interventions and the deterioration rates of assets.

Some types of asset are replaced on a 'like for like' basis, where the new asset is substantially of the same specification as the old one. In this case, the condition of the asset should be returned to 'new', but the deterioration rate/relationship would be unchanged and the rise in monetised risk over time would be the same as before, albeit starting from an improved position.

On the other hand, for some types of investment, the performance of the asset on replacement is markedly different from the original. In such cases the condition is then modelled as new and the rise in monetised risk over time follows a different relationship than that of the original asset. A particularly significant example of this is the replacement of iron mains by PE pipelines, as can be seen in Figure 2. It is evident that as the makeup of the asset base changes from Iron to PE, the net deterioration rate will reduce.

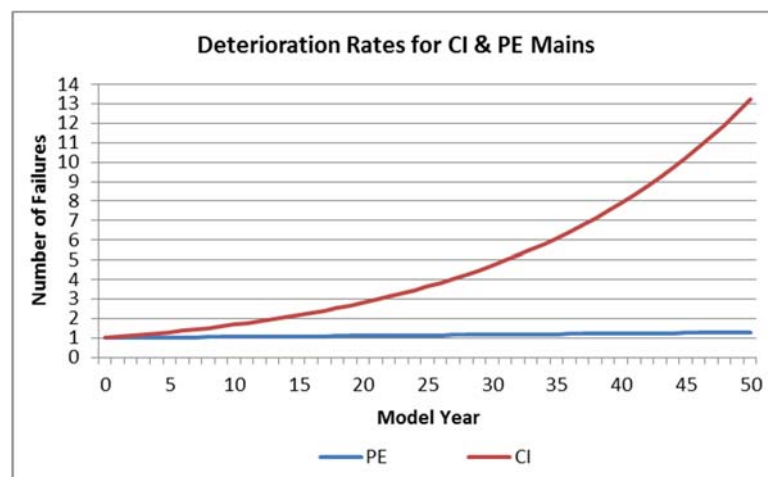


Figure 2 Deterioration (failure) Rate of PE & CI through time

When deciding on the technique to use to rebase a model the impacts detailed above will need to be taken into account to ensure the outputs are robust. Individual GDNs will need to articulate and justify their approach to support their submission.



## 6. Calculating the Rebased Position as April 2013

There are two broad methodologies that can be used to calculate the rebase starting position (point A):

- Re-construct the 2013 asset base and apply the MR methodology
- Apply the MR methodology to today's assets, extrapolate performance to account for interventions since 2013

Regardless of how the asset base for 2013 is derived the 'with investment' forecast of monetised risk (point C) will be calculated from the 2013 position using a 2014/15 cost base (as used in the models). This derivation will be produced from the FP investment plan (see section 7).

### Method 1: Restating the Asset Base & Condition/Performance

Describe the asset base and the condition/performance of assets as it was in 2013 and use the MR methodology to calculate the rebase position. There are three mutually exclusive sub-methods to establish the 2013 position. Each will be presented in turn and then their application discussed:

#### 1.1 Where the performance and asset base are known

*For example: Where an asset snap shot is kept within a company's core systems and performance records of the time are available. For example at Cadent, mains data is kept in a GIS system and the associated failures are kept in a corporate enterprise system SAP.*

Input required: An archived snapshot of the asset base in 2013 and its associated condition/performance.

To be calculated: No calculation required, point A is available.

#### 1.2 Where the condition/performance before intervention is known but the asset base is not

*For example: Where an asset snap shot is not available but performance records of the time are available. A common example of this is services which are not recorded in corporate systems but their failures are recorded in corporate enterprise systems such as SAP.*

Input required: The current asset base (available in all cases), details of interventions made since 2013, known condition/performance of assets prior to intervention

To be calculated: Derive the asset base by reversing the effects of interventions carried out since 2013 on today's asset base (eg unpick the material change where a pipe has been renewed from CI to PE). Apply known condition/performance values from the start of the period to calibrate models.

Where the actual health and risk pre intervention is not recorded, infill or roll back methods may be used as described below.

### 1.3 Where condition/performance and asset base are unknown

For example: Where there is no available data, as of 2013, associated with either the asset or the performance of those assets. A common example of this is risers, where the asset base was not fully documented as of 2013 and failure records are not available.

There are two variants within this sub-option, depending on whether data prior to 2013 is used to 'roll forward' or after 2013 to 'roll back'

Roll back

Input required: The current asset base (available in all cases), details of interventions made since 2013, the deterioration rate in model for current assets (available in all cases)

To be calculated: Run time backwards through the MR methodology, starting with 2017 asset base and condition/performance levels, to reverse the effects of deterioration to 2013 values. In addition, remove known investments made since 2013.

This differs from method 2 below, as the asset base can be modified to reflect interventions and resulting changes in the deterioration profile, allowing the model to be used to derive 2013 condition/performance levels. That is to say, in this approach, the 2013 asset base is recreated, as in 1.1 or 1.2, but the condition/performance assigned is derived from the 2017 performance in the model.

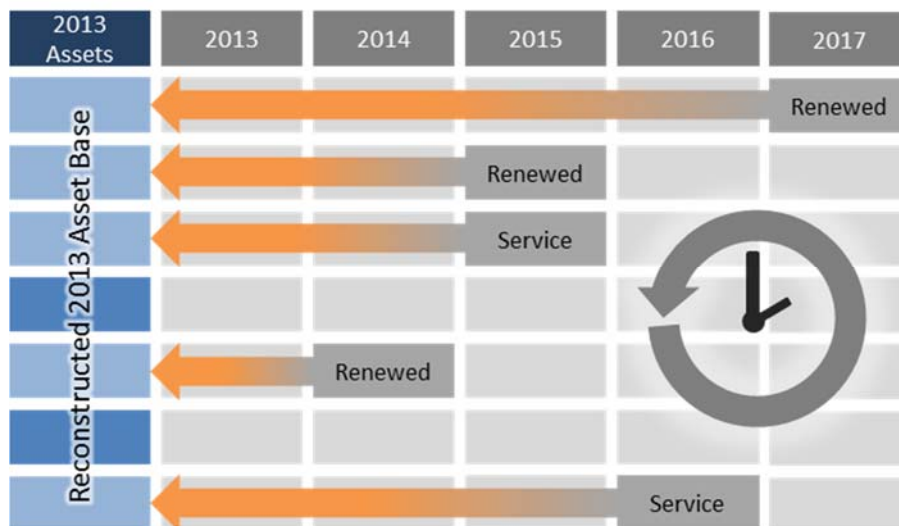


Figure 3 Stylised Representation of Rebasing Method 1

Roll Forward

Input required: An asset base prior to 2013 (available in some cases through past survey), details of interventions made since this asset base was recorded, the deterioration rate in model for current assets (available in all cases)

To be calculated: Run time forwards through the MR methodology, starting with the pre 2013 asset base and condition/performance levels, to build in the effects of deterioration to 2013 values. Furthermore, make any changes to reflect the impact of known investments between the survey and 2013, so that the assets reflect the 2013 position and not the surveyed position. As with roll back, this differs from method 2, as the asset base can be modified to reflect interventions and resulting changes in deterioration profile, allowing the model to be used to derive 2013 condition/performance levels.

The diagram below shows an example in which asset and condition information has been collected in 2011. Interventions delivered between the date of the survey in 2011 and the start of GD1 in 2013 can be accounted for in order to derive the position as at 1 April 2013. In addition, the roll forward would deteriorate the existing assets that have not been subject to intervention, in line with the established deterioration rates in the model.

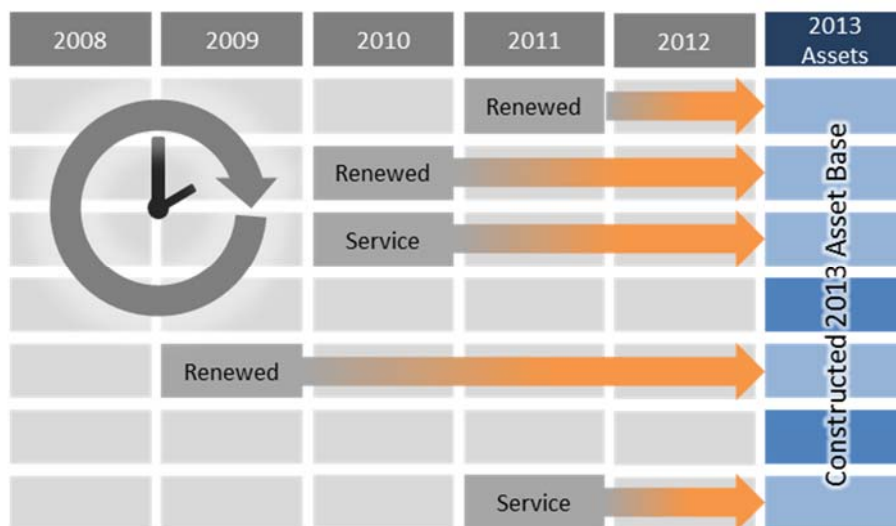


Figure 4 Stylised Representation of Rebasing Roll Forward

## Method 2: Extrapolation

Input required: The current asset base (available in all cases), the deterioration rate in model for current assets (available in all cases).

To be calculated: The total risk reduction benefit delivered in 2013-2017.

This method requires the blend of assets in the asset base to remain the same. That is, that new assets have the same deterioration rate/relationship as those that have been replaced. This removes the risk highlighted in the 'Factors Affecting Monetised Risk Rebasing' section regarding the different deterioration relationship between the new and the original asset

This methodology uses today's asset base and its deterioration as a proxy for the 2013 asset base and its deterioration.

First, use the deterioration of the current asset base to calculate the 2017 without investment baseline forward to 2021. Then, extrapolate this curve backward to 2013 and uplift the whole curve by the interventions (risk reductions) carried out to date to infer the 2013 without investment baseline.

In other words, use the MR model to calculate the deterioration rate of the current asset base forwards (Figure 5 Stylised Representation of Rebasing Method BD) and then use the gradient of this curve to extrapolate backwards (BF). This curve describes the shape of deterioration over the period 2013-2021.

The whole curve then needs to be uplifted to the actual start position of 2013 (F to A) and end point (D to E). Using the same curve for AE, as for FD, is acceptable if we assume that the blend of the asset base has not materially changed. GDNs using the extrapolation method will present justification to support their approach as part of individual methodologies.

To determine the start and end MR position without investment (AE), the benefit of investments carried out to date need to be assessed and then used to uplift the whole FD curve. That is to say, E is not calculated by running a model forward from A as A is not known, but rather by uplifting position D, which has been calculated from position B. To assess the benefits of investment may require GDNs to know the condition of an asset before any intervention was carried out on it. Pre-intervention condition data may not be universally captured and may need to be assumed, as described in the example above. See Appendix 1 for the assumptions that will be used to identify the 1 April 2013 start position.

To calculate the MR position with investment in 2021 (C), the final business plan interventions need to be worked through the MR methodology, beginning with the performance calculated for point A.

Note, as illustrated in Figure 5 Figure 5 Stylised Representation of Rebasing Method , that the MR position in the current year may not be on a linear path (AC), as the delivery profile may not be evenly distributed over the RIIO period.

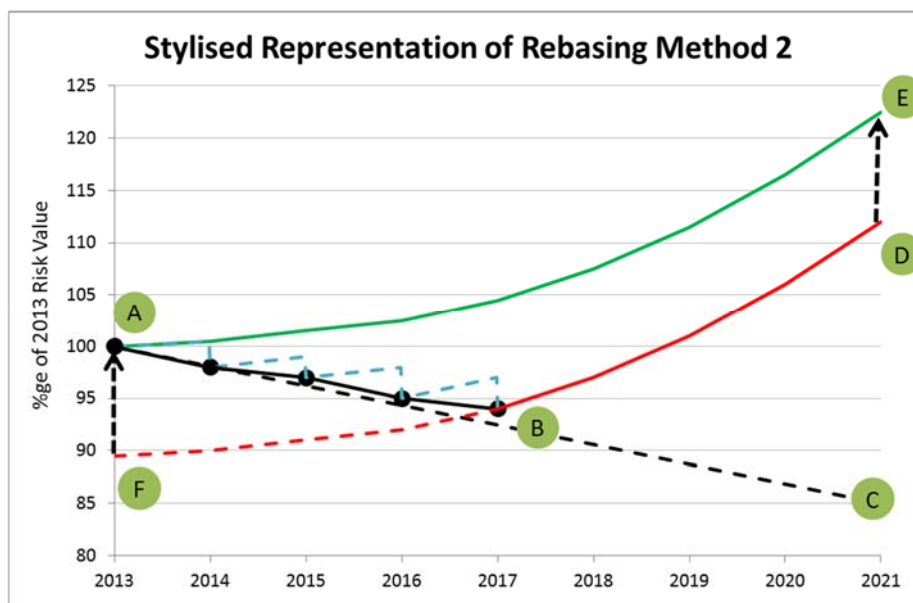


Figure 5 Stylised Representation of Rebasing Method 2

The extrapolation method can be used, where the change in performance is known, but it is applicable only where the rate of deterioration doesn't change with intervention. This is because today's asset base and its deterioration are used as a proxy for the 2013 asset base and its deterioration. The implications of this approach have been statistically tested and the SRWG is confident that it is realistic. GDNs using this methodology will provide additional information in their individual rebasing submissions.

If the method is applied to an asset where deterioration changes with intervention (for example mains: CI renewed with PE) the result will not represent the true 2013 starting value, due to the difference in deterioration rates or changes in the blend of assets. However, the variance resulting is within the uncertainty inherent in the model.

### Discussion of options

Where a GDN has an archived snapshot of performance and the asset base from the start of the regulatory period, the application of the MR methodology is relatively easy and is very robust (Method 1.1).

However, where condition/performance and/or an asset snapshot are not available a significant amount of work is required to re-configure the 2013 starting point.

One method to re-configure the 2013 asset base is to identify interventions that have taken place since 2013 and reverse their effect (Method 1.2). This method works where the effect of the intervention is clear, for example, where CI mains have been replaced by PE mains. As is the case for method 2, this method will require GDNs to know the condition of an asset before intervention was carried out on it. Pre-intervention condition data may not be universally captured and may need to be assumed for this method to work. See Appendix 1 for the assumptions that can be used to identify the 1 April 2013 start position.

Another method to re-configure the condition/performance of the 2013 asset base is to use the MR methodology to reverse the effects of interventions and deterioration (Method 1.3). This method is suitable where there is not adequate data to substantiate asset condition or performance in 2013 and where interventions have an effect on the rate of deterioration. The method works where survey data has been captured since the start of the RIIO period and assets deteriorate at a fixed rate. A good candidate for this methodology is risers, since extensive survey programmes have resulted in GDNs having more information about risers today and deterioration on these assets can be modelled at a fixed rate. For these reasons, the methodology could be used to reverse deterioration in line with that applied in the forecasting of future risk. By taking into account survey completion dates, the calculated level of risk would reflect the asset risk at the start of the RIIO period. This method would ensure a consistent statement of rebase risk across the GDNs and be compliant with the MR methodology.

## 7. Summary of Methods

On the basis of evidence provided by GDN's in their network specific rebasing submissions all rebasing methodologies are valid approaches to restating the 2013 starting position and deriving the 2021 risk delta are valid.

The methodology GDNs will employ to lead to the most robust results will depend on practical considerations for each network. The explanation and justification of the rationale behind their chosen approach will be provided in the GDN's supporting narrative as part the rebasing submission. Each GDN will demonstrate that whichever rebasing approach is adopted the treatments of known data error are properly explained and assumptions of asset conditions are appropriately justified.

Method		Strengths	Restrictions	Suitable Application Where:
1.1	Actual 2013 asset base and performance	Uses actual 2013 asset base and levels of performance	Requires GDNs to have asset and performance data preserved from 2013	<ul style="list-style-type: none"> <li>the 2013 asset base is known</li> <li>the 2013 performance is known</li> </ul>
1.2	Unpick Investments to Reset the Asset Base	Asset base resembles 2013's asset base Deterioration rates reflect the mix of assets in the asset base in 2013	Assumptions required to unpicking interventions The age and condition of an asset before renewal may not always be known	<ul style="list-style-type: none"> <li>the 2013 asset base is unknown</li> <li>the 2013 performance is known</li> <li>the rate of deterioration changes on intervention</li> </ul>
1.3	Run the Model in Reverse to Reset the Asset Base	Asset base resembles 2013's asset base Deterioration rates reflect the mix of assets in the asset base in 2013	Performance of the 2013 assets inferred from today's performance	<ul style="list-style-type: none"> <li>the 2013 asset base is unknown</li> <li>the 2013 performance is unknown</li> <li>the rate of deterioration changes on intervention</li> </ul>
2	Extrapolation	Simple to implement as it doesn't require asset base restoration	Will lead to over / understatement if applied where deterioration rates change through time	<ul style="list-style-type: none"> <li>the 2013 asset base is unknown</li> <li>the 2013 performance is unknown</li> <li>the rate of deterioration doesn't change on intervention ie the new asset deteriorates at the same rate</li> </ul>



## **8. Equivalent Impact – 2021 with investment**

To derive point C, the with investment position at 2021, GDNs will build the interventions (the volume of work to be delivered) agreed at FP into the risk model. Each GDN will provide details on this process as part of their individual rebasing submissions.

The restated intervention plan will, where possible, be a direct translation of the original intervention plan and as such the new targets will have an equivalent impact to that of the original targets.

That is to say, the work identified at FP will be classified into the agreed intervention types and fed into the model. All intervention types have been agreed by the SRWG and the approach to applying interventions has been defined in the monetised risk methodology.

If workloads are not explicitly defined in the FP then workloads will be used from GDN's business plans. There will be no attempt to revise the original intention of the business plan.

For asset replacement or refurbishment the intervention volumes should be consistent with the intervention volumes in each asset category that was included as part of company business plans, with any updates resulting from FP being accounted for.

Similarly, we are aiming to model the change in asset condition resulting from investment described in our business plans in the new risk framework. If condition change errors are identified in the original plan these should be corrected and commentary provided as part of the rebasing submission.

Thus, the volume of intervention and types of intervention should be the same in the FP and in the new risk methodology and therefore the risk reduction associated with investment will be as equally challenging as the original targets.

## Testing

We propose that a number of tests could be applied to provide assurance that the rebasing process generates a plan with equivalent impact to that originally submitted. Given the difficulty of using a process that did not exist at the time of the original submission to create outputs as they would have been four years ago it will not be possible to pass all the tests for all assets. The tests do provide a structure for reviewing the rebasing process and will highlight areas which require additional consideration and control. Each GDN will provide detailed commentary around their performance against the tests are part of their submission.

Test	Description	Pass Criteria
<b>1</b>	<p>Asset base test</p> <p>To ensure that the asset base used in the MR risk models reflects the actual 2013 asset base.</p>	<p>Pass: The 2013 asset base represented in the model exactly represents the 2013 asset base</p> <p>Issues: The asset base is based on the best data available, but is not exactly as 2013</p> <p>Fail: A very large number of assumptions have been used to derive an asset base</p>
<b>2</b>	<p>Volumes of investment test</p> <p>To ensure the volume of the specific intervention driver is the same volume as that stated in the original FP business plan.</p>	<p>Pass: The volume of interventions represented in the model exactly represents the number of interventions stated in the FP</p> <p>Issues: To map interventions a number of assumptions have had to be made</p> <p>Fail: A very large number of assumptions have been used to assign interventions in the model</p>
<b>3</b>	<p>Asset condition/performance test</p> <p>To ensure that the modelled asset conditions and performance is the same as that of the 2013 asset base.</p>	<p>Pass: The condition and performance of the assets represented in the model represents the condition/performance of the assets in 2013</p> <p>Issues: A number of assumptions have been used to derive and assign an condition/performance</p> <p>Fail: A very large number of assumptions have been used to derive and assign an condition/performance</p>
<b>4</b>	<p>Consequential test</p> <p>To identify if any investment is made in condition grades where it would not be expected.</p>	<p>Pass: Interventions are mapped against assets with the same condition as the company based the GD1 plans on.</p> <p>Fail: Interventions are not mapped against assets with the same condition as the company based the GD1 plans on.</p>

NB] The new risk methodology will obviously introduce a greater range of 'risk removed per intervention' than in the original 5 x 5 methodology, but will represent the same work outputs in a different format. Put another way, although the intervention may be the same, the calculated consequence will be different as the method of calculation has changed with the introduction of MR.

## Appendix 1: Assumptions

Two broad alternative approaches to calculating the rebase have been identified:

1. Re-construct the 2013 asset base and apply the MR methodology
2. Apply the MR methodology to today's assets, extrapolate performance and account for interventions since 2013

For the methodologies to work, a number of assumptions will be required to restate the asset base where assets have been refurbished, removed or have deteriorated since the start of 2013/14:

- For assets where Refurbishment has occurred, the input data to the MR models shall reflect the 'pre-refurbishment' values.
- For assets removed after 1 April 2013, the MR model input data shall represent either the inputs as at the end of 2012/13, or the last recorded data for these assets.
- Where input data representing the inputs after 1 April 2013 is to be used, it is for the licensee to consider the deterioration of assets since 1 April 2013.

It is recognised that not all the required input data may have been captured. For example, an asset's condition at the start of 2013 or condition of an asset pre intervention may not be known. In such circumstances, any data gaps will be filled using currently held data and/or infilling techniques. The explanation and justification of the rationale behind their chosen approach will be provided in the GDN's supporting narrative.

The application of these assumptions by GDNs will be covered as part of individual rebasing commentaries.